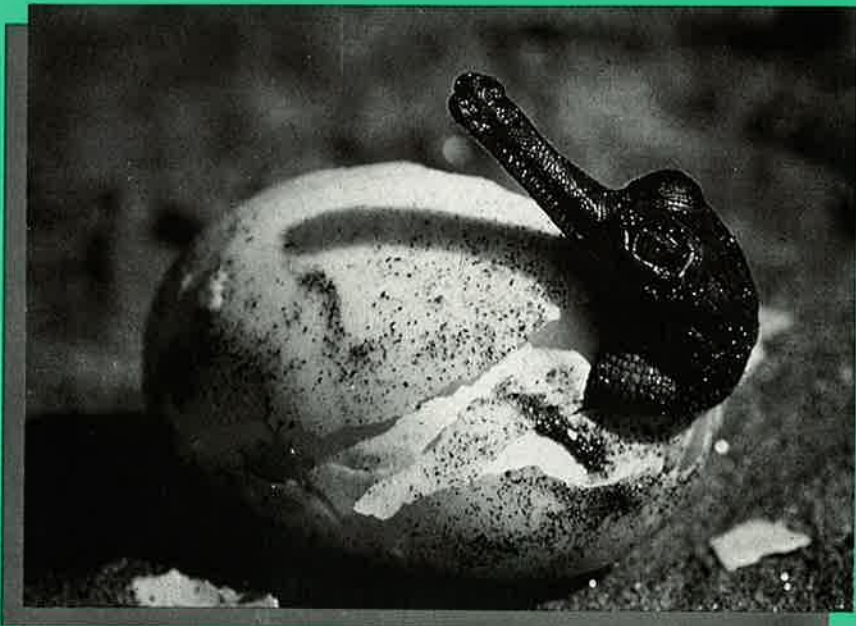


IUCN Nepal and USAID
NGO Environmental Management Programme

Crocodile Conservation in Nepal

By Harry V. Andrews and
Preston McEachern



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1994
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Crocodile Conservation Project

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NGO Environmental Management Programme

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Citation: Andrews, H.V. and McEachern, P., 1994. Crocodile Conservation in Nepal, Kathmandu.

Designed by: Sunil R. Shrestha

Cover
Photograph: T.M. Maskey

Available from: IUCN Nepal. Attention: NEMP
P.O. Box 3923
Kathmandu, Nepal

This publication has been prepared under the NGO Environmental Management Programme. The role of USAID in supporting NEMP is gratefully acknowledged. The Swiss Development Cooperation has assisted in the establishment of IUCN's Desktop Publishing Unit.

Preface

Crocodile conservation began in Nepal with legal protection in the early 1970's. This did not develop into actual conservation action until 1978 with the creation of the Gharial Project. Over the interim years the Gharial Project has reintroduced gharial and mugger crocodiles in the lowland protected areas of Nepal. Due primarily to lack of funds and personnel, there has been no comprehensive assessment of released animals and the current status of both species is still unquantified. The current rate of habitat degradation along floodplain and river banks due to intensive agricultural practices has led to further depletion of habitat required to sustain viable crocodile populations in Nepal. There have been no attempts to educate people on the values of maintaining riverine habitat and the important link crocodiles play in healthy wetland ecosystems.

Statement of Philosophy: The creation of the Crocodile Conservation Project, funded by USAID and IUCN Nepal, is an attempt to reverse some of the above-mentioned trends and improve not only the status of crocodile numbers in Nepal but also wetland conservation.

Acknowledgements

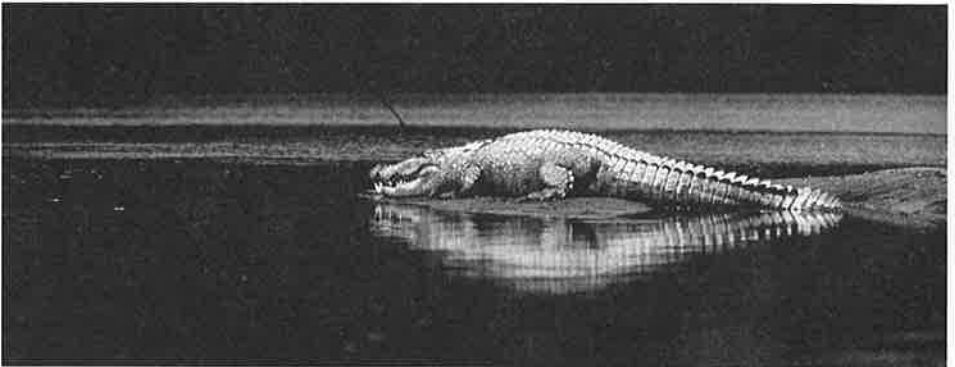
The formulation of this document was made possible through the interest and assistance of IUCN Nepal. The guidance given by John McEachern of IUCN Nepal, as well as Dr. Tracey Parker and Dr. Dan Miller of USAID has been instrumental in the implementation of the crocodile project. Their support allowed a visit by the senior author to assess the direction of crocodile conservation in this country. Additional assistance and data were supplied by the Department of National Parks and Wildlife Conservation (DNPWC) staff, particularly Dr. T. M. Maskey and the Chief Warden of Royal Chitwan National Park, Mr. R. Yadav. Dr. Uday Sharma, the Director General of DNPWC, granted us permission to conduct studies in park areas.

Special thanks go to key Crocodile Specialist Group members of IUCN's Species Survival Commission who reviewed and gave valuable constructive

criticism of this report: Romulus Whitaker, Graham Webb, Perran Ross, Wayne King, Anthony Sebastian, and Clarence Abercrombie. Other reviewers included Romaine Andrews and Indraneil Das.

Finally, the invaluable help of field assistants Dan Obrecht and Shree Krishna Shrestha is gratefully acknowledged as well as the guidance of T.B. Shrestha.

Adult mugger (*C. palustris*) basking on a river bank in Nepal



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Executive Summary

1. Two species of crocodylians occur in Nepal, the gharial (*Gavialis gangeticus*) and the mugger crocodile (*Crocodylus palustris*). By the early 1970s, both species were reduced to isolated remnants due to over-exploitation prior to protection, habitat loss, intensive fishing, and more recently, interference of river courses by barrage construction.
2. Legal protection was obtained in 1973 through the National Parks and Wildlife Conservation Act.
4. The Gharial Conservation Project was initiated in 1978 with a center at Kasara in Royal Chitwan National Park (RCNP) and later expanded to Bardia Wildlife Reserve in 1982. IUCN—The World Conservation Union initiated a program for mugger conservation in 1992.
5. Around 300 mugger and 432 gharial have been released since 1981.
6. Although the reintroduction program for both species continues, successful captive breeding has not been achieved. Upgrading the existing infrastructure and the development of an integrated project is necessary to mitigate this deficiency.
8. At present, there are an estimated 100 gharial in the wild and 140 in captivity. There are 120-150 mugger in the wild and 99 in captivity.
9. The Nepal crocodile program requires restructuring to consolidate its achievement and ensure effective progress.
10. Recommendations
 - a. Creation of a crocodile technical committee as part of the existing Wetlands Group.
 - b. Initiation of a country-wide survey in order to: i) determine present status of restocked crocodiles; ii) locate

additional crocodile habitats for future restocking; and
iii) to survey areas where existing crocodile stocks have not yet been quantified.

- c. Designation of the Kali Ghandaki River north of RCNP and the western Rapti as gharial and mugger sanctuaries. Beeshajar Tal, a secondary wetland west of Sauraha, should be considered for a conservation development program. The creation of "Buffer Zones" to protect habitats along both riverbanks in Nepal is urgently needed. Local people should be recruited to monitor these sanctuaries.
- d. Continued restocking of both species for the next five years with yearly monitoring. A comprehensive assessment will be necessary at the end of this 5-year period to determine release success and future management practices.
- e. Technical options explored for the Ghandaki Barrage on the Narayani River to expedite gharial, mugger, dolphin, and fish migration up-river. A proposal should be created to implement design changes. Requirements for similar considerations in all future dam developments must be incorporated in the 1994 National Wetland Protection Act under draft.
- f. Maintenance of a captive breeding stock for both species to ensure conservation of genetic diversity.
- g. Inauguration of a training and participation program to sustain interest and supply of crocodile researchers and managers.
- h. Initiation of a feasibility study to explore opportunities for commercial farming and ranching of mugger under "eco-development programs" wherein a portion of the revenue directly benefits crocodile and habitat conservation. Focus should be on people in the vicinity of crocodile habitats, whose involvement is essential for crocodile conservation and habitat preservation.

1 Range and Status of Nepal's Crocodiles

1.1 Species

Nepal has two species of the family Crocodylidae, to which all modern crocodylians belong. The mugger, *Crocodylus palustris*, (subfamily Crocodylinae) is listed as vulnerable and on Appendix I of CITES. The gharial, *Gavialis gangeticus*, (subfamily Gavialinae) was on the verge of extinction with less than 150 adults surviving throughout its range in 1974. Subsequent breeding and restocking programs in India and Nepal have raised the total wild population to over two thousand (Whitaker, 1987). The gharial is listed as endangered and on Appendix I of CITES. The characteristics of both species are outlined in Table 1.

Table 1: Characteristics of Nepal's Crocodile Species

		Gharial <i>G. gangeticus</i>	Mugger <i>C. Palustris</i>
Distinctive Features		Large, extremely slender-snouted species; adult male has conspicuous narial excrescence locally termed "ghara"	Broadest-snouted of the Crocodylidae, post-occipital scutes present
Maximum Size	Males	7 m	5 m
	Females	4.5 m	3 m
Size at Maturity	Males	4 m	2.7 m
	Females	3 m	1.6 m
Habitat Type		Exclusively riverine large open, and deep rivers	Any freshwater habitat from village ponds and oxbows to large reservoirs
Diet		Specialised fish eaters	Age-related diet preferences; insects, mollusks, crustaceans, fish, amphibians, reptiles.
Breeding Season	Mating	February	November
	Nesting	March-April	February-March
	Hatching	June	May-June
Nest Type		Hole nesters	Hole nesters
Clutch Size		10-60	10-50
Hatchling Size		35 cm	25-40 cm
Temperament		Mild, social	Aggressive, social
Skin Type		Classic	Classic

1.2 Distribution and Range

Both species exist on the Indian subcontinent. Their historical ranges extended from Iran for the mugger, and Pakistan for the gharial to Bangladesh. (see *Figure 1*).

Gharial (*Gavialis gangeticus*)

The gharial occurred in many river systems in Nepal (see *Figure 2*): the Mahakali, the Karnali, the Babai and Bheri to the west; the Narayani and its tributaries including the Kali Ghandaki in central Nepal; and in the Sapta Kosi Tappu Region to the east (Maskey & Mishra, 1981).

Currently, they are distributed in isolated remnant populations in the Karnali, Babai, and Narayani river systems, all of which are in or adjacent to protected reserves. Gharial populations in the Mahakali and Sapta Koshi Rivers are low (See *Figure 2*). A survey conducted in 1989 found nine gharial in the Karnali River and seven in the Babai River (Maskey, 1990).

In India, their range is restricted to the Ganges River and its main tributaries. Scattered populations occur in Pakistan on the Nara and Indus Rivers, and in Bangladesh on the Jamuna and Padma Rivers.

Mugger (*Crocodylus palustris*)

The mugger was also widely distributed in Nepal. Their habitat range included most of the Terai, the West and East Rapti, the Narayani, and the Koshi River Systems. In the Karnali, Narayani and Babai they co-existed with the gharial (see *Figure 3*).

Currently, the mugger is reduced to isolated populations primarily in protected habitats, such as Royal Sukla Phanta Wildlife Reserve, Bardia, and Royal Chitwan National Parks which contain the last viable populations. A limited number have been reported from the Sapta Koshi area and the Lumbini district. The Mahakali and Bahuni Rivers adjacent to Sukla Phanta represent excellent habitat and are contiguous with areas in Uttar Pradesh where an effective rehabilitation program is in operation. Recent surveys by IUCN Nepal revealed depressed numbers in this area.

Figure 1: Ranges of Gharial and Mugger on the Indian Subcontinent

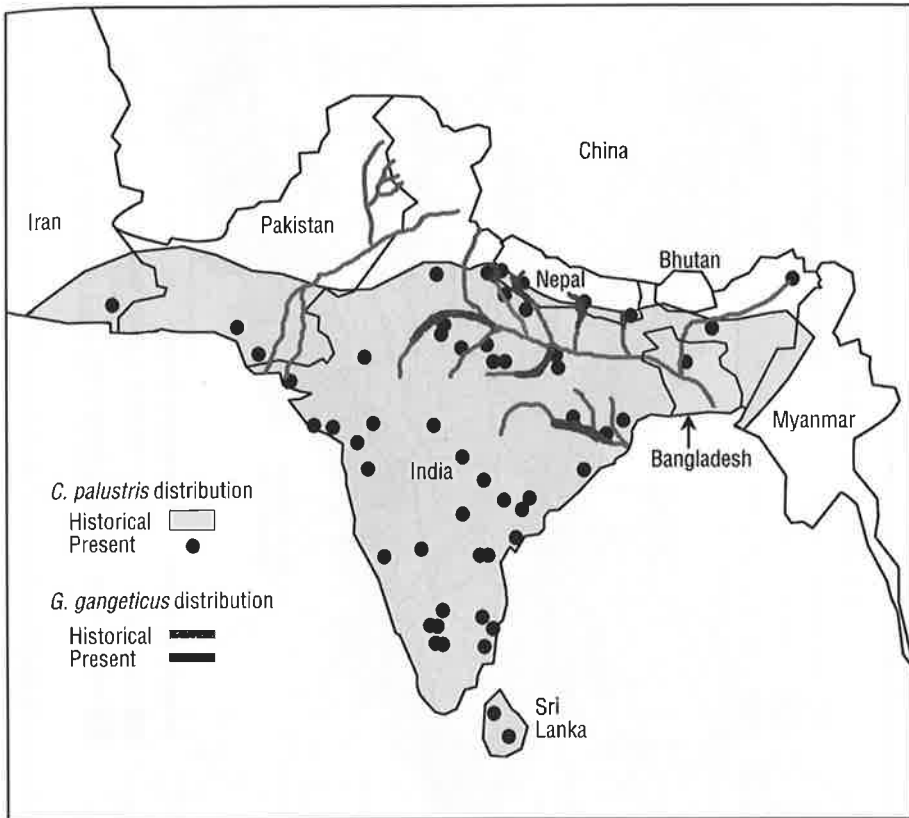


Table 2: Crocodile Numbers in the Wild and Captivity
(Estimates based on IUCN project surveys and available data)

<i>G. gangeticus</i>		<i>C. palustris</i>	
Captive	Wild	Captive	Wild
140	100-150	99	120-150

1.3 Causes for Decline

Habitat loss has been a leading cause for Nepal's declining crocodile populations. This was accelerated in the mid-1950s when an intensive malaria eradication program opened the Terai for habitation. Approximately 7.6 million (40 percent) of Nepal's human population live in the Terai.

Intensive fishing has reduced food levels and effected crocodile numbers. They become entangled in nets and either drown or are killed by fishermen. Fishermen view them as competitors for a limited resource needed to feed people. Subsequently, egg collection and slaughter of crocodiles by tribal hunters have been on-going as a deterrent to fishing competition, as a food item, and for body parts thought to have medicinal value.

In recent years, the construction of dams and barrages has blocked migratory routes. Hatchlings which emerge during the monsoon season are flushed below the barrages and cannot return during post-monsoon seasons. Adults are similarly effected as populations from upstream areas move into vacated habitats and are flushed below the barrage in subsequent years. This continual draining and blocking of recruitment by barrage construction be addressed. Indian programs should consider upstream habitats in Nepal for future crocodile releases. Obviating the negative impacts of barrages will facilitate migrations of fish, turtles, and dolphins as well. Support from international organizations, such as IUCN, WWF, and AWB, will help implement suitable designs.

1.4 Conservation Measures

Legal protection began in 1973, under the National Parks and Wildlife Conservation Act. Hunting of crocodiles is no longer permitted.

HMG Nepal launched a captive breeding program in 1978. Eggs are harvested from the wild and incubated in protected areas. Hatchlings are raised to 1-1.5 metres, then released. Releases began in 1981 (see *Table 2*).

The rearing project, originally for gharial only, was set up at Kasara in Royal Chitwan National Park. The facilities in Kasara now hold both gharial and mugger. In 1982, facilities were added at Bardia National Park for gharial and mugger. The objectives of the program are to rebuild populations of both species in protected and unprotected areas, and to determine the status, ecology, and behavior of crocodiles in Nepal.

To achieve these objectives, the following methods were adopted: egg collection from the wild; incubation under hatchery conditions; rearing to appropriate size for release; release of juveniles and sub-adults into protected areas.

IUCN Nepal initiated a program for mugger in 1992 which derived from the accelerated decline of wetland habitat and lack of detailed information on the status of crocodiles. The recently created Wetlands Inventory and Conservation Programme augments the crocodile project by supplying logistic support and facilities. The Crocodile Project received funds from USAID and IUCN for the initiation of a conservation program and a feasibility study for sustainable utilization of crocodiles in Nepal. The main objectives of the project are:

- 1) better management, understanding, and interest in crocodile conservation;
- 2) establishing a buffer zone conservation area outside Royal Chitwan National Park to protect wetland habitats;
- 3) local involvement to heighten conservation awareness and generate economic benefits to locals;
- 4) diversifying tourist interests and relieving pressure within RCNP by integrating tourism into a captive breeding facility adjacent to RCNP;
- 5) generating revenue from tourist visitations to sustain the project;
- 6) training student-based survey teams to monitor Nepal's crocodile populations;
- 7) providing model for similar areas along Nepal's Terai belt (Koshi Tappu, Lumbini, Bardia, and Ghodaghodi Tal);
- 8) educating locals by providing school trips to the site and offering facilities to university students interested in wetlands, wildlife, and other biological research.

Table 3: Gharial Releases and Release Sites

Year released	Number	Release site	Protected Area	Size class
1881	50	Narayani River	RCNP	Sub-adult
1982	50	Narayani River	RCNP	Sub-adult
1983	25	Narayani River	RCNP	Sub-adult
1983	35	Kali Gandaki River	RCNP	Sub-adult
1983	42	Sapta Koshi River	KTWR	Sub-adult
1984	15	Narayani River	RCNP	Sub-adult
1985	5	Rapti River	RCNP	Sub-adult
1986	42	Sapta Koshi River	KTWR	Sub-adult
1990	30	Babai River	RBNP	Sub-adult

Source: Maskey, 1990.

1.5 Research and Training

The Gharial Project in Nepal has resulted in data being collected and published on both mugger and gharial by DNPWC, with support from other sources. However, there remains considerable scope for further study of crocodile biology and ecology. There has not been extensive monitoring of the released animals. Populations have been monitored only in the Narayani and Rapti Rivers. Monitoring efforts at these locations indicate that reintroduced animals are thriving. However, high attrition is attributed to flushing downstream below the Tribeni Dam.

Since crocodile conservation began in Nepal, only two senior staff of DNPWC have been involved in crocodile research. Although specialists in crocodylian biology and management in Nepal are limited, there is an active technical expertise for wetland conservation and management which can be tapped. Training conservation officials and implementing student programs must be initiated immediately.

As a consultant to the IUCN Crocodile Project, the senior author shared his knowledge with the DNPWC staff at the Kasara Gharial Project. Rangers were trained in handling, clip-tagging, sexing, and facility improvement.

There is an urgent need to encourage a continued supply of crocodile researchers through education. Government funds, external funds, and university grants should be earmarked to support students. Student and training programs have been successful in India. The Madras Crocodile Bank has agreed to assist. Recently, Global Environment Funds (GEF) were made available through KMTNC for training park personnel some of these funds could be applied towards crocodile conservation training, according to Mr. Gurung, Director of KMTNC.

Although the Gharial Project has reintroduced animals, there has been no progress persuading people to live with crocodiles due to lack of both public education and concern over diminishing crocodile habitats. The project is in jeopardy if suggested inputs are not added with dispatch.

1.6 Captive Breeding

There have been attempts at the Gharial Project at Kasara in RCNP since 1978, to breed gharial in captivity. The breeding stock, one male and seven females, are well over three meters. Breeding occurred for the first time in 1994, resulting in seven fertilised nests. Hatching success and survival of the captive bred gharial will be published by T. M. Maskey. Breeding did not occur in previous years because the male had not reached breeding size.

Two adult mugger crocodiles are also held at Kasara. During our visit they were sexed and determined to be females. For successful captive breeding, Nepal must acquire adult and sub-adult mugger and gharial. Efforts are now underway by DNPWC, IUCN Nepal, and the Madras Crocodile Bank in India to achieve this goal.

1.7 Releases and Present Stock

Since crocodile management commenced in Nepal, the program has maintained data on species, numbers involved, and location of releases (see *Table 3*). Some 432 gharial and 300 mugger have been released from rearing stations to the wild. The remaining 140 gharial and 99 mugger are held in captivity.

Gharial have been successfully re-stocked into the Narayani, Babai, and Karnali Rivers. 1978 hatchlings released in 1981 have started breeding. Reintroduced mugger have not been monitored.

2 Strategy and Management Options for Nepal

To secure the conservation of crocodiles in Nepal, wild populations must be economically valuable to local people because their long-term survival depends on locals. Rearing for hides, meat, and by-products, must be incorporated with adequate safeguards for wild populations.

Over the past 15 years of crocodile conservation in India it has become apparent that no program will succeed without sustainable utilisation. Most protected habitats are stocked and, because mortality is higher than natural replacement, restocking must continue. However, if breeding facilities have no access to revenue they face a limited future. The present policy's myopia of obviating sustainable utilisation of crocodiles, will effect the collapse of what has been a successful conservation program. Without program to support monitoring, the threat of habitat loss from human encroachment will escalate. In Nepal, a commitment to sustainable utilization of crocodiles is essential to their conservation.

The following recommendations are made for Nepal:

- 1) Review national and international legislation and treaties that are likely to effect the availability of gharial and mugger for commercial trade.
- 2) Commence mugger ranching in the Terai with local benefits accruing to Surkhet, Bardia, Kailali, Kanchanpur, Chitwan, and other areas.
- 3) Establish commercial captive mugger breeding wherein a portion of the revenue benefits crocodile conservation.
- 4) Develop experimental gharial ranching to benefit local people under eco-development programs.
- 5) Develop an industry for products derived from crocodiles, including leathers, meat, oil, and other byproducts. To ensure that only legally farmed or ranched crocodiles are utilized, a marking system must be devised to protect wild populations from poaching.

2.1 Precedents from crocodile management elsewhere

Despite the enormous pressures faced by many of the world's 22 crocodylian species, particularly from habitat loss and over-exploitation, conservation efforts have been notably successful.

Crocodile conservation is not a simple case of preservation. Most of the species which remain endangered can never regain their historical numbers because their habitat has disappeared. A number of species, such as *Alligator*

sinensis in China and *Crocodylus mindorensis* in the Philippines, have no natural habitat remaining. These species most graphically illustrate the reality that crocodylians will not survive in the wild unless locals tolerate or, preferably, value them. Ironically, it was the crocodylians' high value which caused their decline and will now be used to sustain them.

Sustainable use programs encourage people to maintain wild crocodiles and their habitat because they generate economic benefits. In Louisiana, U.S.A., landowners with alligator swamps sell eggs to ranchers. In Zimbabwe, rural communities sell Nile crocodile eggs. In some circumstances, the benefits accrue directly to conservation programs. In 1992, the Convention of International Trade in Endangered Species (CITES) accepted that captive-produced specimens of the highly endangered Chinese alligator could be commercially marketed. Income generation is essential for captive breeding efforts to succeed and remaining wild populations to persist.

There are precedents for innovative and imaginative crocodylian conservation and management. Nepal is in a unique position to adopt these conservation models under eco-development programs designed to benefit local people in the vicinity of crocodile sanctuaries.

2.2 The Crocodile as a Resource

The mugger is an ideal animal for ranching and farming; it has a "classic hide" valuable on the world market. In Nepal, ranching could contribute to feral mugger conservation and habitat preservation by generating revenue for local communities on whose goodwill crocodiles depend for survival.

The mugger crocodile's range extends from south-eastern Iran through Pakistan, India, Nepal, Bhutan and Sri Lanka. In Nepal, the populations are restricted to isolated pockets across the lowland Terai (see *Figure 3*). In India, there are well over 12,000 in captivity with existing potential for 5 to 10,000 hatchlings per year. These statistics indicate that it is not a globally endangered species and can be sustainably utilized (see *Figure 1*). Net income of US\$ 125 to 150 for a 2-3 year old animal can be expected. Experimental ranching and well-managed farming programs in Nepal could generate immediate revenue for crocodile management and protection and justify the survival of this species and its habitat. This would afford enduring benefits to not only the mugger but also Nepal's entire wetland ecosystem, including avifauna and herpetofauna.

2.3 Establishing Additional Conservation Areas

The conservation of crocodiles and wetlands requires construction of a breeding facility combined with a demonstration wetlands management area. Planning and implementing a conservation project of this magnitude would be a Sisyphean task if one were to begin from scratch. Fortunately, there is a successful model for such a facility. The Madras Crocodile Bank Trust (MCBT), inaugurated in 1976, has become the leading center for herpetological studies on the Indian subcontinent. MCBT maintains over 10,000 reptiles from 38 different taxa, 10 of which belong to the crocodile family. It has been successful at captive breeding in seven crocodile species. This resource has provided a laboratory for herpetological research by both Indian and foreign investigators. The MCBT has been a base for 37 student researchers from India, U.K., U.S.A., and Israel.

A facility of this nature would assist in conserving Nepal's crocodylians, in increasing their reproductive success rate, and in sustaining reintroduction of animals into the wild. In concert with a wetlands management program, the facility could demonstrate the feasibility and potential benefits of wetlands conservation, promote research, and provide resource materials for educational programs. The facility should be accessible to researchers based in Kathmandu, as well as to tourists, in order to fulfill its objectives and to tap into visitation revenues.

Beeshajar Tal in the Tikauli Forest area, administered by the Ministry of Forests, provides excellent habitat for mugger. It is the proposed site for IUCN's pilot crocodile conservation area and wetland management project, due to its superior habitat and tourist access. At present, this site is threatened by the destructive fishing practice of draining the wetlands to expedite fish harvesting. A proposal detailing implementation, design, management, costs, and contribution to restocking was tabled at a discussion on February 15, 1994, with HMG Nepal. The proposal is a collaboration between IUCN Nepal and the Madras Crocodile Bank Trust.

3 Recommendations

3.1 Crocodile Technical Committee

A technical committee to coordinate an action plan must be included in the Biodiversity Action Plan to guide Nepal's crocodile conservation efforts. It should be incorporated into the extant Wetlands Group of 25 scientists and

administrators involved in wetlands and related resources which meets regularly at IUCN's offices in Kathmandu.

3.2 Survey for Additional Habitats in Nepal

Suitable habitats in Nepal for crocodile proliferation are not known. Surveys should include information on habitat availability, restocking capacity, local perspectives, and extension work requirements for successful releases.

In selecting restocking sites, questions to be addressed are:

- 1) Did the site ever support a natural crocodile population?
- 2) Does the area have the legal status to ensure protection?
- 3) What kinds of extension work will be required?
- 4) Are locals resistant to co-existing with crocodiles?
- 5) Will restocking effect local use of water resources?
- 6) Are primary habitats available for breeding adults and secondary habitats available for young?
- 7) Is the site sustainable with limited inputs?

If a site has been used for prior restocking, future restocking should be determined by assessing the fate of previously released individuals.

3.3 Creation of Crocodile Sanctuaries

Sanctuaries are necessary for adult populations to mate and reproduce. Recruitment of local people to monitor and protect the crocodiles is essential to success. The following areas should be considered for future protection of crocodiles in Nepal:

The West Rapti and Kali Ghandaki: The west Rapti contains both mugger and gharial. The Kali Ghandaki is a fast flowing but excellent habitat for gharial. Each should be designated "Conservation Areas" to protect these vital habitats. Conservation Areas already exist in Nepal, whereas buffer zones are still being considered. Conservation Areas can be administered by NGOs, a situation that has proved successful in the Annapurna area under the King Mahendra Trust for Nature Conservation.

Buffer Zones along Riverine Habitat: The riverine habitat of Nepal is as valuable as it is fragile. Both mugger and gharial require undisturbed river banks for

basking and nesting purposes. Protection of forest corridors defined by river channels would help control erosion and siltation, thus benefiting many other wildlife species. Forest reserves can be effectively maintained through community-oriented management involving local forestry and administration personnel.

Non-Government Organisation Captive Breeding Facility (Beeshajar Tal): The success of conservation efforts for crocodiles has been augmented by an emphasis on commercial utilisation, converting altruistic goals into direct, monetary benefits. The creation of a private captive breeding facility is necessary if conservation efforts are to move away from government. In other countries, private crocodile facilities such as MCBT have attained greater breeding and survival success than government-run facilities. The IUCN Nepal proposal for a captive breeding facility at Beeshajar Tal requires immediate endorsement by HMG Nepal and expedient implementation. In addition to captive breeding and head-start programs, the facility should act as a resource for educational programs and a model for habitat management.

3.4 Captive Breeding and Restocking

An intensive 5-year restocking program is mandatory for rebuilding wild populations. In addition to appropriate release sites as delineated in the surveys, greatest success will be achieved in conservation areas, buffer zones, and other protected habitats. A minimum 5-year monitoring program is essential.

Captive breeding should be actively pursued to ensure the maintenance of a diverse gene pool for long-term species survival. Revenue generated by selling hatchlings to farmers from captive breeding facilities could be used for crocodile and wetland conservation.

3.5 Development Conflicts

Development projects which interfere with rivers downstream from release sites and protected areas must be made "fauna friendly." The Tribeni barrage is an example of a development project that has not incorporated wildlife migration considerations reaping disastrous consequences for crocodiles, fish, and dolphin populations in the Narayani River.

A National Wetland Protection Act is being drafted for 1994 which should incorporate technical options for facilitating faunal migrations along river

channels. International agencies mandate conservation measures in all development projects to mitigate externalities.

3.6 International Cooperation

Cooperation with India is essential for the conservation of crocodiles in Nepal. Most of the habitats are contiguous with those in India, particularly along the Narayani, Gandaki, and Karnali-Girwa Rivers.

Nepal can benefit from consultation with India which has a strong crocodile conservation program, and India can benefit from Nepal's releases into habitats contiguous with theirs. There is some urgency to bilateral cooperation if crocodile population losses to India from Nepal continue without replacement.

3.7 Wildlife Management

The Nepalese Army is responsible for guarding National Parks and the wildlife within. There are two problems with this arrangement: (i) army units take their orders from a chain-of-command which does not include DNPWC officials, but rather generals in Kathmandu; (ii) funding agencies interested in wildlife protection will not support Nepal's military.

A management scheme that places wildlife officials in the chain-of-command for army units patrolling wildlife reserves is essential to successful conservation. Commanding officers in protected areas should be given authority for decisions based on weekly meetings with chief wardens to allow those on site to implement appropriate protective measures. Dialogue between DNPWC staff and the Army, with a clear outline of responsibilities is mandatory. Ownership of facilities for enforcement such as boats and radios must be placed under DNPWC to ensure their availability for wildlife protection.

A formal infrastructure, with parks personnel in the loop, will liberate funding for protection measures.

Wildlife outside protected areas receives marginal protection. Extension work and legislative changes would allow crocodiles to make the transition from a threat to a beneficial status within communities where no protection exists.

3.8 Database

A crocodile database to contain survey information has been created by IUCN Nepal. This relational database is on 4th Dimension for Macintosh and contains files relating individuals to locations, nests, and releases for an accumulation of life history information. An organizing body to input the information, maintain the database, and create maps and summary reports must be formalized. IUCN Nepal has tentatively accepted this responsibility and has started producing survey maps and data sheets.

4 Institutional Support

IUCN Nepal has contacted several organisations regarding the crocodile conservation program. Each has expertise to contribute to the program. The Madras Crocodile Bank Trust, India, and the IUCN-SSC Crocodile Specialist Group, can offer resources in crocodile management. The King Mahendra Trust for Nature Conservation, a Nepalese NGO, has effectively created and implemented conservation areas in Nepal. It has training resources and a strong network within the RCNP area. Additional agencies include the Asian Wetlands Bureau, the World Wide Fund for Nature Conservation, and USAID.

In addition to organisations, there are a number of Nepalese and Indian specialists who are active in crocodile management and research:

4.1 Nepal

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Mugger (*C. palustris*) in a breeding pond at the Madras Crocodile Bank, India

